bridge Geology, Mr. Marr on Advanced Palæontology, especially the Graptolites, Mr. Harker on Microscopic Petrology.

In Botany Dr. Vines is lecturing on the Cryptogams; Mr. F. Darwin on Physiology, and Mr. Potter on Advanced Systematic Botany.

In Zoology, Mr. Sedgwick continues the courses of Elementary Biology, and the Anatomy and Embryology of the Vertebrata; Mr. Gadow gives a summary Course on the Palæontology of the Vertebrata.

In Physiology, beside Prof. Foster's Elementary Course, we have advanced lectures by Dr. Gaskell, Dr. Hill, and Mr. Langley.

Prof. Macalister lectures on the Variations in the Skeletal, Muscular, and Nervous Systems of the Races of Mankind.

The Special Board for Physics and Chemistry report to the Vice-Chancellor on the new Mechanical Science Tripos:—

In consequence, the report states, of the Grace passed March 11, 1886, confirming their report, dated December 14, 1885, the Board have drawn up regulations for the New Tripos in Engineering, Physics, and Chemistry, for which they would propose the name "Mechanical Science Tripos." They do not think it desirable that the University should examine in subjects for which the University does not or may not easily provide adequate teaching, and have therefore made the examination in Engineering mainly an Examination in Mechanical Engineering. They have included, however, in it such elementary portions of Civil Engineering as can be taught in Cambridge and such as may often be advantageously studied by those who are intending to become Mechanical Engineers. With respect to the Engineering papers in Part II. of the Examination one paper would test the ability of the candidates to indicate how a given design should be carried into execution; another would include questions on steam and the steam-engine besides other prime movers, and also on boilers and furnaces; a third would include questions on bridges, roofs, arches, abutments, elementary hydraulics, strength of materials, and elementary building construction. In the Examination in Physics in Part II. the papers would contain questions on the application of dynamics to physical phenomena; gravitation; attractions; hydrostatics and hydrodynamics; properties of matter, including elasticity, capillarity, diffusion, and viscosity; heat; kinetic theory of gases; radiation; light, including the application of the undulatory theory to the problems of geometrical optics; mineralogical physics; acoustics; meteorology; cosmical physics; electricity and magnetism; reduction of observations. The Practical Examination would extend over two days, the Examination on the first day being of such a nature as would test the knowledge of the candidates in the general methods of laboratory work; on the second day a list of experiments would be given, one or more of which each candidate would be expected to complete.

SCIENTIFIC SERIALS

Bulletins de la Société d'Anthropologie de Paris, tome 8eme, 4me fascic., 1885.—On the facial and cranial muscles of a young gorilla, by M. Chudzinski. The subject of this post-mortem examination, a young male, was 98 centimetres in height. The muscles of the head and face were the same in number as in the human species, but in form and dimensions they exhibited certain differences, being combined into a single fleshy mass, which covered most of the face.—M. Pozzi laid before the Society various anatomical characteristics with reference to the comparative constitution of the muscles of the Negro and the white races.—M. Folley drew attention to the greater anastomosis of the subcutaneous abdominal veins of the Negro, and the importance of this peculiarity in giving to the organism a greater power of resisting the action of rapid variations of atmospheric or aqueous pressures.—On the common origin of Malays and Vedahs, by M. Beauregard.—On the universal language of F. Sudre, by M. Gajewski. The basis of the system proposed fifty years ago by M. Sudre is the musical nomenclature of the vocal notes, *do, re*, &c., and from these he elaborated a language which claims to be equally capable of expression by means of musical instruments and the voice. The defects and impracticabilities of Sudre's proposed musical language were considered at length by MM. Kerckhoffs, Dally, and Dehoux.—Suggestions for the modification of Broca's method of determining the direct absolute cranial capacity, by M. Topinard. The points chiefly insisted on are the different results yielded by fresh, and often-used, lead, the latter being valueless after 100 cubage determinations.—On the cause and nature of the vitrification observed in tumuli, and other ancient structures, by M. Manouvrier.—Report of the recent Anthropological Exposition at Buda-Pesth, by Dr. R. Blanchard.—On the dimensions and location of the dolmens of St. Nectaire, by Dr. Verrier.—History and anthropology, by Dr. Fauvelle. The writer draws attention to the tissue of errors which works intended for the instruction of the young continue to promulgate, as exemplified in the current historical explanations of the origin and usages of earlier races.—On the Gallic habitation of Mané Gohenne, Carnac, by M. Gaillard. The finds, which consisted principally of flints and pottery, included a string of twenty-three green serpentine beads cut into various forms.—On certain unique objects shaped like fishes, found in the Mammoth Cave in Varsovia, by M. Zawisza, and supposed to have been employed as fetishes by sorcerers.—On the significance of certain strongly marked impressions on the inner surface of a skull, by M. Manouvrier. Such impressions have been regarded as an evidence of imperfection in the cerebral convolutions, and of consequent mental deficiency.—On man of the age of Palæolithic pottery in the Lozère district, by MM. Martel and L. de Launay. The local finds attest the co-existence there of man and the cave-bear, and the fabrication of pottery at the time.—On the flint implements of Croix Fringant, near Cognac, by M. Germain.—On the calcareous islets of Taled Sah, in the inner sea of the Samsans, in the Malayan peninsula, and the natives who dwell in natural caverns and are engaged in collecting edible swallow-nests, by M. Macey.—On the displacement of the brain in accordance with the different attitudes assumed by the body, by M. Bonnard.—On the form of the hand and figure of Asiatics, by Dr. Mugnier.—Anthropometric and other observations of three Australians now being exhibited in Paris, by M. Topinard.—On the development of the cranium in the gorilla, by M. Deniker. It is found that, while the frontal region is developed, like other parts of the cranium, as rapidly in the gorilla as in man from the middle of fœtal life to the eruption of the milk molars, different relations supervene after the latter period, the cranial development of the gorilla becoming much more strongly marked in the posterior and inferior than in the anterior regions. At the same time the upper maxillary rapidly acquires its characteristic prognathic form. An almost equal degree of prognathism is observable in the adult Negro, or Australian, and in the infant gorilla, but with its growth the latter acquires a facial angle which is smaller than that of any human cranium.—Ethnographic observations on the cerebral function, by M. Fauvelle.—On a case of an hermaphrodite, by M. A. de Mortillet.—Notes on the post-mortem appearances of an imbecile, by MM. Doutrebente and Manouvrier.—Report, by M. Letourneau, on the Godard Prize Essay of M. de la Calle (1885) on the earliest attempt at speech in infants. M. de la Calle attempts to draw a parallel between the first enunciation of the vowel-sounds *a, e, o* by infants, and the monosyllabic character of certain languages belonging to various peoples of the far east of Asia, which have scarcely yet entered upon the more advanced stage of lingual agglutination.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 15.—"Dynamo-Electric Machines." By John Hopkinson, D.Sc., F.R.S., and Edward Hopkinson, D.Sc.

Omitting the inductive effects of the current in the armature itself, all the properties of a dynamo-machine are most conveniently deduced from a statement of the relation between the magnetic field and the magnetising force required to produce that field. This relation given, it is easy to deduce what the result will be in all employments of the machine, also the result of varying the winding of the machine in armature or magnets. The magnetic field may be expressed algebraically as a function of the magnetising force, or more conveniently by a curve (*Proceedings* of the Institution of Mechanical Engineers, April 1879, p. 246). Amongst the empirical formulæ which have been proposed to express the electromotive force of dynamo-machines in terms of the currents around the magnets, we may mention that known as Fröhlich's, where $E = \frac{ac}{1 + bc}$, E being the electromotive force of the machine at a given speed, c the exciting current, and a and b constants. For some machines this hyperbola is said to express observed results fairly accurately. In our

experience it does not sufficiently approximate to a straight line in the part of the curve near the origin, and gives too high results for large values of c.

One purpose of the present investigation is to give an approximately complete construction of the characteristic curve of a dynamo of given form from the ordinary laws of electromagnetism and the known properties of iron. Let n be the number of convolutions on the magnets, c the current round the magnets, l_1 the mean length of the lines of force in the iron of the armature, A_1 the area of section of iron in the armature, l_2 the distance from iron of armature to iron of pole pieces, A_2 the area of the magnetic field in which the wires move corrected for its extension round the edge of the pole pieces, l_3 the total length of the magnet cores, A_3 the area of the magnet cores, l_4 the mean length of lines of force in the yoke connecting the magnet limbs in machines of the type on which we have principally experimented, A_4 the area of section of the yoke, l_5 the mean length of the lines of force in each pole piece, A_5 the main area of section of pole piece, I the total induction through the armature when no current passes in the armature, and νI the total induction in the magnet cores; and, finally, let the relation between the magnetic force (α) and induction (a) (*vide* Thomson, "Electrostatics and Magnetism," p. 397, and Maxwell, "Treatise on Electricity and Magnetism," vol. ii. p. 24) be represented by the equation $\alpha = f(a)$, then the characteristic curve is—

$$4\pi nc = l_1 f\left(\frac{\mathrm{I}}{\mathrm{A}_1}\right) + 2l_2 \frac{\mathrm{I}}{\mathrm{A}_2} + l_3 f\left(\frac{\nu \mathrm{I}}{\mathrm{A}_3}\right) + l_4 f\left(\frac{\nu \mathrm{I}}{\mathrm{A}_4}\right) + 2l_5 f\left(\frac{\mathrm{I}_5}{\mathrm{A}_5}\right).$$

If the relation between α and a be given in the form of a curve, this formula indicates at once a perfectly simple graphical construction for the characteristic. Taking the curve of magnetisation determined by one of us for wrought iron, and constructing a characteristic in this way, we have obtained a theoretical curve which agrees over a long range with the actual results of observation on a dynamo-machine more closely than any empirical formula with which we are acquainted.

To determine ν, a wire was taken once round the middle of one magnet and connected to a ballistic galvanometer, a known current was then either suddenly passed round the magnets or short-circuited, the elongation of the galvanometer being noted. A similar observation was made with the same current, the galvanometer being connected to a single convolution of the armature in the plane of commutation. The ratio of the two elongations is the value of ν.

The distribution of the waste field $(\nu - 1)$I was roughly ascertained in a similar manner.

The currents in the fixed coils round the magnets are not the only magnetising forces applied in a dynamo-machine. The currents in the moving coils of the armature have also their effect upon the resultant field. In well-constructed machines the effect of the latter is reduced to a minimum, but it can be by no means neglected. This introduces a second independent variable, viz. C, the current in the armature. The effect of the current in the armature depends upon the lead given to the brushes. Denote this by λ, which we may also regard as an independent variable, as it is subject to arbitrary adjustment.

If $\mathrm{I} = \mathrm{F}(4\pi nc)$ be the characteristic curve when no current passes through the armature, then

$$\mathrm{I} + \frac{\nu - 1}{\nu} 4\lambda m\mathrm{C}\frac{\mathrm{A}_2}{l_2} = \mathrm{F}\left(4\pi nc - \frac{4\lambda m\mathrm{C}}{\nu}\right),$$

where m is the number of convolutions in the armature. Here we omit the comparatively unimportant portion of the magnetic force in the core of the armature and the pole pieces. From this formula it is not difficult to deduce a geometrical construction for the characteristic surface (*vide* "Practical Applications of Electricity," lectures delivered at the Institute of Civil Engineers, 1882–83, p. 98). The equation may be thus expressed in words, if λ be such that the coils at commutation embrace the whole or nearly the whole induction. The effect of the current in the armature upon the difference of potential between the brushes of any machine, is the same as that of an addition to the resistance of the armature proportional to the lead of the brushes, and to the ratio of the waste field to the total field, combined with that of taking the main current $\frac{m\lambda}{\nu n}$ times round the magnets in a direction opposite to the current c. Many consequences can be deduced, of which we may notice the following:—In a series-wound dynamo C is equal to c, and if c be increased beyond a certain point, I must attain a maximum and then diminish; this has been frequently observed. We now see that it depends upon the existence of a waste field. Secondly, let the coils of the magnets be entirely disconnected, and let λ be the negative; if the armature be short-circuited through a small resistance and be run at a sufficient speed, a large current may be produced in the armature. This latter deduction we have verified by direct experiment.

The efficiency of the type of dynamo-machine upon which the experiments before indicated have been made, has been accurately determined by the device of coupling two similar machines, both mechanically and electrically, so that one should act as a generator of electricity, driving the other electrically, whilst the latter acted as a motor driving the former mechanically; the loss of power required to keep the whole combination in movement being determined by direct dynamometric measurement, and the power passing electrically from the one machine to the other being measured by ordinary electrical appliances.

The whole of the experiments were carried out at the works of Messrs. Mather and Platt, to whom we are indebted for the exceptional opportunities we have enjoyed of putting theoretical conclusions to the test of experiment on an engineering scale.

Zoological Society, April 20.—Prof. W. H. Flower, F.R.S., President, in the chair.—Mr. O. Salvin, F.R.S., exhibited a living specimen of a foreign worm (*Bipalium kewense*), found in a garden in Sussex.—The Secretary read an extract from a letter addressed by Mr. R. A. Sterndale, F.Z.S., to Sir Victor Brooke, concerning a case of hybridism between *Ovis hodgsoni* and *O. vignei*.—Mr. J. Bland Sutton, F.Z.S., read a paper in which he gave an account of some of the investigations he had made during the past twelve months into the diseases affecting the mammals living in the Society's Collection.—A communication was read from Dr. O. Finsch, C.M.Z.S., describing a new species of wild pig from New Guinea, which he proposed to call *Sus niger*.—Mr. Smith Woodward read a paper on the relations of the mandibular and hyoid arches in a Cretaceous shark (*Hybodus dubrisiensis*, Mackie).—A communication was read from Prof. R. Collett, of Christiania, C.M.Z.S., containing an account of the hybrid between the willow-grouse (*Lagopus albus*) and the black grouse (*Tetrao tetrix*), which occurs occasionally in Norway, Sweden, and Northern Russia, and of which the author had examined altogether thirteen specimens, most of them of the male sex.—Mr. G. A. Boulenger, F.Z.S., gave the description of a new Iguanoid lizard living in the Society's Gardens, for which he proposed the name of *Ctenosaura erythromelas*. The exact locality was unknown.—A second paper by Mr. Boulenger contained remarks on specimens of a scarce European frog (*Rana arvalis*) exhibited in the Society's Menagerie.

Royal Meteorological Society, April 21.—Mr. W. Ellis, F.R.A.S., President, in the chair.—Mr. L. J. Petre and Mr. G. B. Wetherall were elected Fellows of the Society.—The following papers were read:—The climate of Killarney, by the Ven. Archdeacon Wynne, M.A., F.R.Met.Soc. The climate is determined partly by its geographical position, and it has the benefit of proximity to the south-west coast, with all the modifying influence of the Gulf Stream. The temperature, however, is locally modified, and a decided difference is found to exist between that of Valencia and of Killarney. The author shows that Killarney is colder than many other places in Ireland, and this he attributes to the fact that it is in a great irregular basin surrounded by mountain ranges for about a third, and by hilly ranges elevated some hundreds of feet above the lakes on most of the remaining two-thirds of the circle.—Note on the probability of weather sequence, by Lieut.-Col. C. K. Brooke, F.R.Met.Soc.—Account of the cyclone of June 3, 1885, in the Arabian Sea, by Capt. M. T. Moss. The author, who was in command of the s.s. *Inchulva*, while on a passage to Bombay had, when near Aden, the misfortune to encounter a most furious storm on the above date. This storm, which was apparently not of very large dimensions, was exceedingly severe, and was accompanied by an immense wave which caused several fine steamers to founder.—Results of solar radiation observations in the neighbourhood of Birmingham, 1874–84, by Rupert T. Smith, F.R.Met.Soc.—Results of meteorological observations made in the Malay Native State of Selangor during 1884, by A. W. Sinclair, L.R.C.P. These observations were taken at four stations, viz. Kwala Lumpor, Klang, Kajang, and Kwala Langat. The mean temperature of the district is about 80°, and the rainfall about 90 inches.

DUBLIN

University Experimental Science Association, March 16.—The following communications were made:—Prof. J. E. Reynolds, on action of silicon tetrabromide on thiocarbamide. —Mr. H. L. Crosthwait, the Forth Bridge.—On the melting-points of minerals, by J. Joly, B.E. An account of experiments with the meldometer, in which the temperature of the platinum strip, acting as the stage of a microscope, was determined in terms of its resistance according to Siemens's formula. It was mentioned that the order of fusibility assumed in Van Kobel's scale is erroneous. The true order seems to be: (1) stibnite; (2) natrolite; (3) adularia; (4) actinolite; (5) bronzite; (6) almandine. The blowpipe being a powerful chemical agent, may evidently mask the phenomena of fusion with secondary effects. Fair comparison is impossible with it, the shape and conductivity of the specimen used affecting the result. Comparison on the meldometer is not open to these objections. It is very advisable that a scientific scale of fusibility should be adopted for the use of mineralogists. If this scale rested on the melting points of easily-prepared salts, it would then always be easy to determine by comparison the melting-point of a mineral. Approximate determinations could thus be readily effected on very minute quantities of matter. In the author's experiments the substances are reduced to a fine powder, the phenomena attending fusion being observed with a 1″ object-glass. These phenomena are often very characteristic and beautiful.

PARIS

Academy of Sciences, April 27.—M. E. Blanchard in the chair.—On the quantitative analysis of the organic carbon contained in soils which absorb free nitrogen, by M. Berthelot. The author's researches on the direct absorption of free nitrogen by various argillaceous soils through certain minute organisms have led him to seek some other measure capable of indicating the proportion of these organisms in the ground. It being apparently impossible to isolate them, some idea of their abundance may still be formed by a quantitative analysis of the carbon entering into the constitution of their tissues. Hence the present inquiry, which promises to raise some new and extremely delicate problems.—Observations relative to the proportion and quantitative analysis of the ammonia present in the ground, by MM. Berthelot and André. The experiments conducted during the last four years by the authors at Meudon on the general growth of vegetation and on the formation of nitric compounds, both in plants and in the soil, have led to certain observations here communicated on the processes employed in the quantitative analysis of the ammonia and the starchy compounds. It is inferred generally that the analysis of the ammonia present in the soil should be made without any desiccation, and that arable ground, when watered, tends continually to liberate the ammonia of the ammoniacal salts contained in it.—On the nitric substances contained in rain-water, by MM. Berthelot and André. A process is explained for determining by analysis the exact quantity of nitric substances conveyed to the earth by meteoric waters.—On the movements of meteorites in the atmosphere, by M. Faye. These remarks are made in connection with M. Daubrée's essay on "Meteorites and the Constitution of the Terrestrial Globe," recently presented to the Academy by the author.—Discourse pronounced at Montdidier on the occasion of the celebration of the Parmentier centenary, by M. Chatin.—Note on the meteorological observations made at the Montpellier School of Agriculture since last summer with the registering actinometer, by M. A. Crova. The results already obtained for the variations of solar radiation in summer require to be modified for the autumn and winter seasons. In autumn the oscillations diminish in amplitude, the two maxima of heat intensity tending continually to approach each other and gradually merge together about noon in winter. —Note on M. Lœwy's formulas for the reduction of the circumpolar stars, by M. Gruey. A process, at once simple and easily remembered, is given for establishing all M. Lœwy's formulas without any sacrifice of accuracy.—Remarks on the appearance of Fabry's comet in April 1886, by M. G. Rayet. The comet, observed at Bordeaux on April 7, 13, and 21, exhibited a very long continuous spectrum from the extreme red to the violet, corresponding with the light of the nucleus and of the three ordinary bands of cometary spectra.—Note on the equilibrium of a fluid mass in rotation, by M. H. Poincaré. Some explanations are offered in connection with M. Matthiessen's note inserted in the *Comptes rendus* for April 12.—On the magnetic rotatory power of the crystalline bodies, by M. Chauvin. Iceland spar and some other birefractive crystals, supposed by Faraday and others to be inactive, are shown to possess the property of magnetic rotation.—Action of alcoholic potassa on urea, sulpho-urea, and some substituted ureas; inverse reaction of the artificial urea prepared by Wöhler's process, by M. Alb. Haller.—Note on two properties of the urethanes of the fatty series, by M. G. Arth.—On the abnormal secretion of nitric substances in yeast and mould, by MM. U. Gayon and E. Dubourg.—Remarks on *Polystigma fulvum*, Tulasne, a new disease of the almond-tree, by M. Maxime Cornu.—Propagation of the luminous sensation to the non-excited zones of the retina, by M. Aug. Charpentier. From his optical experiments the author concludes that, in the phenomenon of successive luminous induction, the nervous action which gives rise to the sensation is really transmitted to the parts of the percipient medium lying near the excited part. —An attempt at a physiological explanation of the phenomenon of complementary colours, by the late M. Trève.—Heliophotography and the magnetic perturbation of March 30, 1886, by M. Ch. V. Zenger.—Observation of an aurora borealis at Rolleville, Seine Inférieure, coincident with the magnetic perturbation of March 30, by the Abbé Maze.

BERLIN

Physical Society, February 19.—Dr. Pernet reported on the part he had taken in the labours of the International Commission which had for their object the comparative determination of the normal metre. After recounting in a brief historical survey the undertakings carried out in Paris at the end of last century by an International Congress, which, after theoretically determining on the kilogramme and the metre as normal units, produced a normal metre and normal kilogramme of platinum, the speaker discussed the events which in 1878 led to a new international agreement, in consequence of which a new normal metre of platinum-iridium of X-form was prepared and compared with the metre of the Archives. A series of national standards was also compared with the normal metre. The speaker described in a searching manner the arrangements of the Bureau in which the comparisons were undertaken, the contrivances for securing the several comparing rooms against outward disturbances, the means adopted for insuring constant temperatures, and the methods employed in the comparisons, as also in the determination of the expansion coefficients of the rods used. Finally he gave a sketch of his own labours, which had for their object the comparison of a series of normal metre rods of different metals with the metre of the Archives, and the determination whether repeated heatings and coolings between 50° and 0° C., whether concussions, and whether time caused any perceptible changes in the lengths of the rods. As the result of these investigations it was found that the compared national standards, together with their divisions, were exact up to one-thousandth of a millimetre; that, with the exception of steel, which, on account of its changes in hardness, readily yielded modifications of volume and length in the rods made of this material, all the metals out of which the standards were made—namely, platinum-iridium, platinum, and brass—furnished material suitable for normal metre rods; and that repeated heatings and concussions induced no changes passing beyond the limits within which observation fails.—Herr C. Baur described experiments he had made with water-jets, which, issuing from a conically-pointed tube in parabolic curves, were acted upon by certain musical tones so that at some distance from the mouth of the tube they showed a rotation, and that the jet, though broken up into drops behind the apex of the parabola, contracted into a continuous jet. The thinner was the jet the higher must be the tone towards which it was sensitive; the thicker the jet the deeper the tone. Herr Baur had instituted further experiments with water-jets, which he caused to fall on plates. Under certain circumstances there thus arose quite pure tones, which continued as long as the jet hit on the plate. The experiments succeeded best with a Weissmann apparatus, when the jet issued under a pressure of 10 cm. water from a lateral opening of 4 mm. in diameter without tube. Thin window-glass plates and metal plates, which, resting on pedestals, had free movement of vibration, were best suited as receiving-plates. The tone was most certain of occurrence when the node lines of the plates were supported. In the jet itself appeared nodes and ventral segments at some distance from the opening; they were most distinct and regular at its middle; away in the direction of the plates they again became indistinct. If the metal plate

and the water acidified beforehand were connected with a galvanic cell and a telephone, then no interruptions of the current could be recognised during the time of the sounding. The contact of the water-jet with the plate must necessarily therefore be continuous. Herr Baur deemed this mode of excitation very well adapted to the purpose of studying the vibrations of plates. In the discussion following this address it was pointed out from various sides that more than twenty years ago Prof. Tyndall and after him Magnus had instituted experiments respecting the action of tones on water-jets, and that Prof. Tyndall had at the time shown his experiments to the Physical Society in Berlin.

Physiological Society, March 12.—Dr. Gad reported on the experiments he had made on the subject of hæmorrhagic dyspnœa which he had referred to in his last address. If by opening a cannula inserted into the aorta a large supply of blood were taken from an animal, dog or rabbit, then dyspnœa at once ensued, and that in the form of increased inspirations, such as showed themselves in all cases of dyspnœa induced by insufficient conduction of oxygen to the respiratory centre. These heightened inspirations proceeded side by side with a conspicuous sinking of the blood-pressure, and were denominated by the speaker "pneumatorectic" respirations. This respiration was distinguished from normal respiration by regular deep inspirations of unchanged frequency, inspirations in which the middle attitude of the thorax removed farther from the expiratory than was the case in normal respiration. The curve of respiration either then passed over into the normal, or convulsions set in, in which case the blood-pressure rose and the respiratory curve grew altogether irregular. After repeated heavy discharges of blood, the pneumatorectic passed into the "syncoptic" respiration, which was characterised by deep inspirations of very infrequent occurrence, during which the attitude of the thorax after expiration approximated ever nearer to that which it held in a dead body, till the last breath, and so the death of the animal, occurred. These two kinds of respiration, the pneumatorectic and the syncoptic, were perfectly regular and typical; the former showed itself immediately after a heavy discharge of blood, the latter before death. Between these two extreme forms there passed a series of others in an inter-current manner. Of these there was first to be mentioned a very frequent superficial respiration, which was inadequate to the necessities of the organism, and had the name "hypokinetic" applied to it. If the animal recovered out of this stage, the hypokinetic passed into the pneumatorectic and the normal respiration, otherwise it was followed by the syncoptic respiration and death. The transitional process from the hypokinetic into the pneumatorectic respiration might be experimentally brought about in a perfectly regular manner by the injection into the venous system of warm physiological solution of common salts. With the increase of the blood-pressure the alteration in the form of respiration at once asserted itself, the respiration becoming sufficient. Even at the stage of syncoptic respiration a transition into the pneumatorectic respiration might occasionally, though not always, be induced by injection of solution of common salt, and in that way the life of the animal be rescued. Another form of respiration following heavy bleeding was that which showed itself in periodical increasings of the amplitudes in respiratory movements. These and diminishings of amplitudes ran parallel to the Traube-Hering periodical oscillations of the curves of blood-pressure, though with displacement of the phases. The periodical oscillations in the amplitude of respiration referred to formed a transition to the Cheyne-Stokes phenomenon. The speaker recounted the explanations of the Cheyne-Stokes respiration, and took sides with the older theory, according to which it was to be conceived as a rhythmus of activity on the part of the central organs having periods of a higher order than had the simple rhythmus of respiration. In conclusion Dr. Gad drew from his physiological experiences a series of practical consequences having respect especially to the suitability of transfusions of common salt after heavy bleedings, particularly at the stage of hypokinetic respiration.—Prof. Zuntz spoke of the nature of the stimulations regulating the normal respiratory movements. The every-day experience that increased muscular activity produced an increased respiratory activity, dyspnœa, had suggested simultaneously to the speaker and to Dr. Geppert the idea of investigating whether the gases of the blood, which were universally assumed to be the sole stimulations of respiration, were adequate to the explanation of this dyspnœa. The experiments respecting which the speaker delivered a report were instituted in common. From the carotid artery of an animal habituated to regular work—a draught dog—were taken quantities of blood which sufficed for the purpose of analysing the gases of the blood. The quantities of blood referred to were taken on one occasion while the dog was in a state of rest, lying comfortably at his ease in his cage; or on another occasion while the dog was at work pulling a loaded car in his usual manner. By an ingenious contrivance, which the speaker described, the discharge of blood was rendered possible without the dog noticing anything of the matter. In a similar manner, by special apparatus, without molesting the dog in any way, they were enabled to measure the quantity of the air breathed in a given time, and to take away small quantities of the exhaled air to be subjected to analysis. The examination of the blood-gases showed that the arterial blood during work contained less carbonic acid and more oxygen than it did during a state of rest. During work the blood contained about 39 per cent. CO_2, and in a state of rest about 40 per cent.; the amount of oxygen, on the other hand, was about 18 per cent. during work, and about 12 per cent. in time of rest. The respiratory activity was, however, during work considerably increased. The quantity of exhaled air during work increased to threefold that exhaled in time of rest, and, corresponding with the increased respiratory activity, the air exhaled during work showed a less increase of CO_2 and a smaller loss of oxygen than in time of rest. The increased respiration during work could not now be caused by the blood-gases, seeing that the contents of the arterial blood in CO_2 were less, and in oxygen considerably more, than during a state of rest. Another stimulus must accordingly act on the central organs of respiration during work. It was possible to imagine that, along with the voluntary excitation of the muscles of the body during work, the respiratory muscles might likewise be stimulated, or that from the corporeal muscles contracting themselves during work a stimulus proceeded reflexively exciting the respiratory centres. The following experiment, however, was against both of these possible assumptions. The spinal marrow of an animal was intersected at the top of the thoracic vertebra, and the paralysed lower extremities tetanised while the anterior part of the body remained at rest. Notwithstanding, however, that all nervous connection between the working muscles and the respiratory centre was cut off, the dyspnœa of work still ensued, and disappeared when the tetanus ceased. From this fact the speaker drew the inference that in the active muscle some product or other was generated which arrived with the blood at the respiratory centre and excited it. The accuracy of this conclusion was further confirmed by the following experiment. The abdominal aorta of the animal with intersected spinal marrow was, during the tetanus of the posterior extremities, strongly compressed through the abdominal integuments. The respiration now continued unchangedly normal, nor did any dyspnœa ensue so long as the compression lasted. Dyspnœa showed itself, however, the moment the compression was removed. Even when the aorta was left free after the tetanus was ended, increased respiration still occurred. The speaker conceived therefore he had conclusively established that a substance, still unknown, forming itself during the muscular activity, proceeded with the blood to the respiratory centre and excited it. He conjectured that, in other active organs as well, such an efficient substance developed itself as respiratory stimulus, a substance which operated along with the gases of the blood even in the normal respiration. In the discussion following this address, Prof. Zuntz mentioned that Dr. Lehmann had made some experiments respecting the effect of acids on the respiratory centre, and had found that the acids excited this centre. This excitation was of course not powerful enough to justify the conclusion that the acid produced during the muscular contraction was the respiratory stimulus in the dyspnœa of work.

Meteorological Society, April 6.—Prof. von Bezold, the newly appointed Director of the Meteorological Institute in Prussia, which is to be reorganised, explained the principles in accordance with which the reorganisation in question would be undertaken. He first gave a short survey of the history of meteorological observations, setting forth how, first, the disciples of Galileo in the Academia del Cimento made use of the newly invented instruments for the observation of temperatures and atmospheric pressure; how, next, as early as the beginning of the eighteenth century, several investigators of nature had arrived at the knowledge that meteorological observations of any

comprehensiveness could be successfully instituted only through the association of a considerable number of observers; and how, more than a hundred years ago, the Societas Palatina in Mannheim had organised an extended network of stations of observation, at which observations were instituted with instruments of the same construction, according to the same plan, and at the same times, and were collected at the central office, and published in a manner which would be deemed exemplary even if issued at the present time. This work was prosecuted till the French Revolution put a termination to it. In Prussia the suggestion of a meteorological institute was made by Alexander von Humboldt, and was crowned with success only in 1847, when, on Humboldt's proposal, Mahlmann was made the first Director of the Meteorological Institute, which was connected with the Statistical Bureau. In 1849 Dove succeeded Mahlmann as Director of the Institute, and held the post till his death in 1879. Meanwhile, however, the necessity of a complete transformation of the Meteorological Institute came to be recognised. Formerly, simple average values for the different stations were calculated, and for these no special stress was laid on the single observation, in consideration that mistakes balanced one another. Now, however, when it was a question of preparing synoptic maps and of obtaining exact maps of the meteorological conditions prevailing at a determinate time over a large area, the value attached to the single observation was a much higher one, and it was of the greatest importance that all the data should be as free from error as possible. It would accordingly be the first task of the Institute to provide all stations of the second and third order with good instruments, carefully to see they are maintained in good order, and to collect the materials of observation. The network of stations of observation would have to be completed and equally distributed, and there were about 200 stations of the second and third order, besides some thousands of subordinate stations, in contemplation. The subordinate stations should be equipped with rain-gauges, and make observations on precipitation, thunderstorms, and such like. A second problem of the Institute was the exact determination of the course of the meteorological elements for the day, the month, and the year, by uninterruptedly continuous observations not only of the climatic factors—temperature, atmospheric pressure, moisture, &c.—but also of the phenomena of the earth's magnetism and electricity. This work would be done by the Observatory, which was completely separated from the Meteorological Institute. The Observatory, under a special direction, was transferred to Potsdam to the Astro-physical Observatory. Two similar Observatories of the first rank, one in Breslau, perhaps, and one in Bonn—at all events, in University towns wide apart from each other—were in contemplation. While the Observatory prosecuted its observations in the quiet of Potsdam, the Meteorological Institute should have its seat in the midst of Berlin, in the edifice of what was formerly the Building Academy, and continue in connection with the lively intercourse of the capital. Irrespective of the service for weather warnings to be introduced perhaps at a later date, which would require to be in proximity to the head telegraph office, the central position should be readily accessible to the different observers who came from the provinces to the capital. The Institute, moreover, should be easily available for all students of science and experts who were in need of meteorological data: such, for example, as agriculturists, physicians, persons engaged in hydraulic labours, &c. The Meteorological Institute should, finally, have as its main function that of being a teaching institute for the scientific training of meteorologists. Its function in this respect should not be merely confined to lectures at the University, but should especially consist of practical work done, under the guidance of assistants, by students and young observers in the Meteorological Institute, similar to what is carried on in chemical, physical, and other laboratories. With this programme in hand, the new Director hoped very soon to bring the Meteorological Institute to the degree of efficiency attained by similar institutes in neighbouring countries, and particularly by the teaching thus imparted to cultivate a new field fruitful of good results for science.—Dr. Weinstein, with reference to his paper recently read to the Society, made some further communications respecting disturbances of the earth's currents which had occurred on January 9 and March 30. On March 30 the disturbances were so great that in the course of the forenoon telegraphic communication in Germany was stopped. Even with currents of 60 Daniells no signs could be forwarded by the telegraph wires. The magnetic elements in Wilhelmshaven showed great simultaneous disturbances, and from the direction of these magnetic disturbances it was inferred that the disturbances of the earth's electricity were the primary, the oscillations of the earth's magnetism the secondary.—In connection with these observations of Dr. Weinstein, Prof. Spörer stated that from March 26 to April 4 a very remarkable and numerous group of spots had been observed on the sun. On March 30 Dr. Less had observed squalls, accompanied with remarkable oscillations of temperature and of atmospheric pressure, and Dr. Assmann read several reports on North Light phenomena which had been perceived on March 30 in Eldena, Greiffenhagen, Magdeburg, and Nordhausen.—Dr. Weinstein further communicated that Prof. Förster had entered into an arrangement for having reports of disturbances observed in the earth's current at once forwarded to the Astronomical Observatory that the state of the sun might be simultaneously examined.

BOOKS AND PAMPHLETS RECEIVED

"Journal of the Statistical Society," March (Stanford).—"Earthquakes and other Earth Movements," by John Milne (K. Paul).—"Transactions of the Institution of Engineers and Shipbuilders in Scotland," 1885–86 (Glasgow)—"The Forest Flora of South Australia," part 7, by J. E. Brown (Spiller, Adelaide).—"Jahrbuch der k.k. Geologischen Reichsanstalt," Band xxxvi. Heft 1 (Hölder, Wien)—"Archives Italiennes de Biologie," tome vii. fasc. 11 (Loescher).—"Sea-Weeds, Shells, and Fossils," by Peter Gray and B. B. Woodward (Sonnenschein).—"A Treatise on Nautical Astronomy," by J. Merrifield (S. Low).—"Birds of Cumberland," by H. A. Macpherson and W. Duckworth (Thurnam, Carlisle).—"Handbuch der Palæontologie," Abtheil. 1, Band 11, Leif. 5, "Myriopoda, Arachnoidea, und Insecta," by S. H. Scudder (Druck, München).—"Handbuch der Palæontologie," Abtheil. 11. "Palæophytologie," Leif. 4, "Coniferæ und Monocotylæ," by Dr. A. Schenk (Druck, München).—"Letters and Journal of W. Stanley Jevons" (Macmillan).—"Solid Geometry," 3rd edition, by P. Frost (Macmillan).—"Recherches sur l'Instabilité des Continents et du Niveau des Mers," by J. Girard (Leroux, Paris).—"Johann Kepler," by C. Anschutz (Prag).—"The Management of Athletics in Public Schools," by G. Fletcher (Lewis).

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